

(19)



Europäisches Patentamt  
European Patent Office  
Office européen des brevets

(11) Publication number:

**0 361 858  
A1**

(12)

# EUROPEAN PATENT APPLICATION

(21) Application number: 89309781.6

(51) Int. Cl.<sup>5</sup>: B65B 55/10

(22) Date of filing: 26.09.89

The title of the invention has been amended  
(Guidelines for Examination in the EPO, A-III,  
7.3).

(30) Priority: 26.09.88 GB 8822551

(43) Date of publication of application:  
04.04.90 Bulletin 90/14(34) Designated Contracting States:  
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## (54) Method and apparatus for aseptic packaging.

(57) In an aseptic packaging system, cartons L are indexed along an aseptic chamber M through which a main stream of aseptic air flows from a main inlet to a main outlet. At sterilizing stations, hydrogen peroxide is sprayed into the cartons L and the cartons L pass under UV germicidal lamps. Then, at a peroxide-removing station, a second stream of aseptic air is introduced, in a heated state and through a secondary inlet E, into the cartons L to vapourize residual peroxide and the second stream, carrying the peroxide, is drawn off through a secondary outlet N into a peroxide recovery circuit (G,K) leading, via a condenser I, a filter J, a fan A and a heater C, to the secondary inlet E.

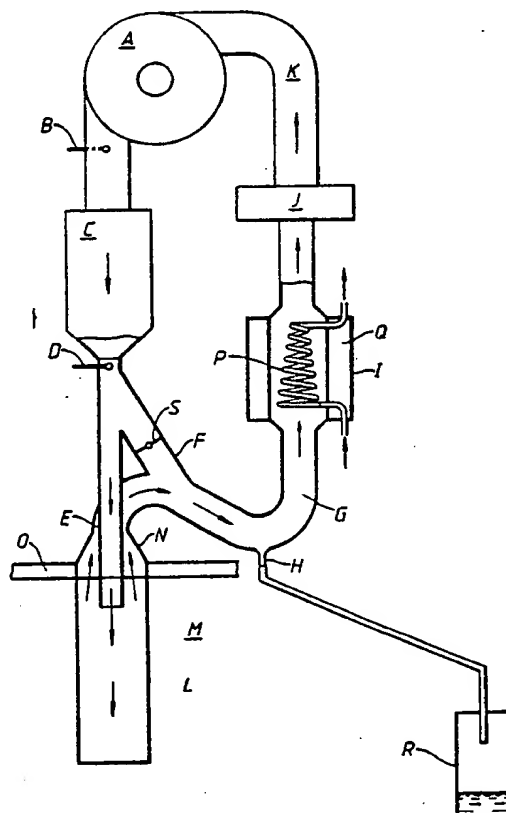


Fig.1.

## PACKAGING

This invention relates to a packaging method and an apparatus for use in the method.

There are two conventional systems of producing liquid packaging cartons.

In one system open-ended carton sleeves formed of paperboard coated on both faces with thermoplastics are individually bottom-sealed, then filled with the liquid and then top-sealed. An example of this system is disclosed in EP0013132, wherein an aseptic packaging machine includes a chain conveyor conveying cartons along a path in an aseptic chamber, which path includes an advance leg and a return leg each extending along the machine. Ultra-violet germicidal lamps extend over at least a major portion of the advance leg. In the region of the beginning of this major portion there is disposed a nozzle arrangement, incorporated in a top closure pre-breaking device, to spray particularly the inside of the carton with hydrogen peroxide. In the return leg, the cartons first arrive at a filling device whereby they are filled with liquid, for example long-life milk. After filling, the cartons are top-heated and sealed at a top-heating station and a top-sealing station. The carton entry to and exit from the chamber have aseptic air curtains. Throughout the operation of the machine, aseptic air is fed from a main sterile air filter to aseptic air inlets of the chamber, in which chamber the aseptic air flows from the inlets relatively smoothly to a front end of the chamber, where the aseptic air leaves via an aseptic air outlet. Not only does the aseptic air act as a scavenging gas removing microbes and hydrogen peroxide from the chamber, particularly tending to prevent the microbes and the hydrogen peroxide from being carried up to the filling device, but the aseptic air also maintains the interior of the chamber at a pressure slightly above atmospheric and thus discourages the entry of ambient air into the chamber. How the hydrogen peroxide vapour created is dealt with is not disclosed.

Another example of this system is disclosed in US 4296068 which describes a commodity packaging apparatus in which a succession of food containers are fed intermittently along a horizontal path within an aseptic chamber from an infeed section and a loading section, through a sterilizing section, a drying section, a filling section and a lidding section to a discharge section. At the sterilizing section, there are formed over and under the feed path two opposed sterilizing chambers into which a sterilizing solution is supplied in subdivided form for application to the successive containers. In some embodiments the sterilizing chambers are provided with spray nozzles for spraying

the sterilizing solution onto the containers, while in others the sterilizing solution is ultrasonically atomized into fine mist in a separate atomizing section, the mist being then directed into the sterilizing chambers. The lower wall of the sterilizing section may have a drain outlet formed therein for carrying off for re-use large drops of the sterilizing solution that may collect thereon. The sterilizing chambers have mist outlets connected to a recovery chamber in which an electrostatic filter or temperature drop means may recover sterilizing solution for re-use. The drying section comprises upper and lower air boxes disposed above and below the containers which receive filtered and heated air under pressure and supply the same as jets to the containers to cause the containers coming out of the sterilizing section to be thus dried and freed of the sterilizing solution. The chamber also has an inlet for filtered air under pressure, this clean air partly flowing through the discharge section and leaving the chamber at the outlet for containers, and partly flowing through the filling section, the drying section, the sterilizing section, the loading section and the infeed section, leaving the chamber through an open top of the infeed section. Again, how the hydrogen peroxide vapour created is dealt with is not clearly disclosed, although it would appear to be blown into the surrounding atmosphere through the open top of the infeed section.

In US4511538, a sterilizing apparatus for packaging jars is equipped with a preparation apparatus for a mixture of hot air and hydrogen peroxide vapour and a closable sterilizing chamber, into which jars to be sterilized are introduced. A closure lid for the sterilizing chamber includes clamps for suspending a jar to be sterilized within the sterilizing chamber. In order to realize a reduced use of peroxide and heating energy, the apparatus has a circulatory system of mixture supply. The sterilizing chamber, as well as a bypass parallel to it, forms a part of this circulatory system. The bypass and the sterilizing chamber are alternately connected with the circulatory system by means of a reversing valve during non-sterilizing and sterilizing periods. A circulating blower, an air heater, and the preparation apparatus are also part of the circulatory system. The circulating blower can also draw in ambient air through a non-return valve. After the supply of mixture to the sterilizing chamber is stopped, the chamber can be left closed for about 3 seconds more, in order to let the peroxide work. Another possibility is to open the chamber and let the peroxide condensate continue to act on the open jar. In this way, the peroxide evaporates more easily. After the chosen time period has elapsed,

the lid is lifted upwards and the jar lifted therewith. The condensed peroxide starts to evaporate immediately subsequent to the treatment period because of the warming of the jar walls by the heat generated in the sterilizing chamber. The remaining small amount of peroxide dries completely with the opening of the sterilizing chamber. Any peroxide traces remaining on the jar surfaces after removal from the treating process can be dried later by blowing hot air over the surfaces. Not only is this sterilizing apparatus totally unsuitable for high-speed handling of packaging cartons, but again hydrogen peroxide vapour appears to be allowed to escape into the surrounding atmosphere.

Hydrogen peroxide vapour needs to be dealt with properly, because not only is an atmosphere containing hydrogen peroxide vapour unpleasant and unhealthy for the operating personnel, but hydrogen peroxide promotes corrosion of metals.

In the other liquid packaging system, a continuously moving web consisting of paperboard coated on both faces with thermoplastics is continuously formed into a tube which continuously advances downwards and is continuously filled with liquid, the tube having respective opposite sides thereof heat-and pressure-sealed together at intervals therealong to form individual, filled cartons, which are then separated from each other by severing at the sealing locations.

An example of this latter system is described in US 3854874, which discloses an apparatus for controlling the atmosphere in a sterile chamber of an aseptic packaging machine, in which the web is first brought into contact with a sterilizing agent in liquid form, for example hydrogen peroxide, and is subsequently led through the interior of the sterile chamber, inside which the packaging material is freed from agent residue, and in which the web is formed into the tube and sub-divided into the individual, filled packages. In this machine, the interior of the sterile chamber forms part of a flow circuit in which the mixture of air and agent vapour forming the chamber atmosphere are circulated with the aid of a fan connected in the circuit, there being a throttle provided between the chamber and the fan for generating above-ambient pressure in the sterile chamber. Upstream of the fan is a liquid separator wherefrom separated agent liquid can be discharged periodically by means of a tap. The mixture of air and agent vapour enters the fan through the throttle and subsequently passes through a filter, in an inlet chamber of which an electrically heated spiral heater is located. From the filter, the heated mixture returns to the sterile chamber through a blowing device in which heated sterile medium is blown on both sides of the web at high speed. The web arrives at the blowing device having been drawn through a bath filled with

agent liquid and then enters the sterile chamber. The agent liquid still adhering to the web is atomized or volatilized by the heated sterile medium into the chamber atmosphere. After passing the blowing device, the web is formed into a flexible tube which is welded together along the sides of the web to form a closed tube. Air for the welding is aspirated from the ambient atmosphere with the aid of a blower, is heated by an electrical heating spiral, is passed through a sterilizer, and is blown into a gap between the two overlapping longitudinal edges of the web with the aid of a hood. During this operation the thermoplastics at the inside of the tube is heated and contact rolls effect hermetic welding with formation of a longitudinal seam. The bottom of the sterile chamber is dish-shaped and at the lowest point a discharge take-off line branches off and leads to the liquid separator. Ambient air is drawn into the circuit at a location upstream of the fan and downstream of the throttle.

US 4055035 discloses another example of the same system, in which the blowing device extends down into the tube and the mixture of sterilizing agent vapour and air so produced is conducted by a hood in the tube into a further hood at the transition between the web and the tube; and then into an uppermost hood wherein an application device for applying the agent liquid to the web is located. An outlet for the mixture from the uppermost hood leads to a liquid ring compressor which operates with a circulating water ring as a sealing medium. An outlet from the liquid ring compressor is connected to a liquid separator, from which the air from the mixture is conducted to a sterile air heater and thence to the blowing device in the tube. Ambient atmosphere is drawn into the circuit at the underside of the uppermost hood.

In the machines of both US 3854874 and US 4055035, ambient air is drawn directly into the hydrogen peroxide recovery circuit, thus requiring a high amount of sterilization work within the circuit itself. Moreover, in the event of a temporary interruption of the advance of the web through the machine, one or more parts of the web are exposed to hot gas for a longer period than planned, which may lead to the cartons produced being faulty.

According to a first aspect of the present invention, there is provided an aseptic packaging method, comprising advancing packaging material through a chamber, causing a main stream of substantially sterile gaseous substance to flow into said chamber through first inlet means, around said material in said chamber, and out of said chamber through first outlet means, applying to a surface of said material a sterilizing agent, allowing said sterilizing agent to act in a sterilizing manner upon said surface, and operating pumping means to introduce

through second inlet means a second stream of substantially sterile gaseous substance to flow over said surface and to entrain the sterilizing agent, characterized in that the second stream comprises sterile gaseous substance drawn from the main stream through second outlet means of said chamber by said pumping means.

According to a second aspect of the present invention, there is provided apparatus for aseptic packaging, comprising a chamber, conveying means for advancing packaging material through said chamber, first inlet means to said chamber for introduction of a main stream of substantially sterile gaseous substance to flow around said material, first outlet means from said chamber for removal of said main stream therefrom, applying means for applying a sterilizing agent to a surface of said material, second inlet means to said chamber for introduction of a second stream of substantially sterile gaseous substance to flow over said surface and to entrain the sterilizing agent, and pumping means for producing said second stream, characterized by second outlet means from said chamber for removal from said chamber of gaseous substance of said main stream to constitute said second stream, and duct means connecting said second outlet means to said second inlet means.

Since the second stream can be drawn totally from the main stream, the second stream circuit need not receive ambient air directly. Therefore, the amount of sterilization work required within the circuit itself can be minimized.

In order that the invention may be clearly understood and readily carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1 shows diagrammatically a station for removing sterilizing agent from packaging cartons and forming part of an aseptic packaging machine, the station being shown in a condition in which it is removing sterilizing agent from a carton.

Figure 2 is a view similar to Figure 1, but showing the station in a condition in which it is not removing sterilizing agent from a carton.

Figure 3 shows a diagrammatic top plan view of the machine, and

Figure 4 shows a diagrammatic side elevation of the machine.

Referring to Figures 1 and 2, the station includes an air fan A downstream of which is an air pressure switch B which detects the air pressure in the circuit including the fan A, in order to maintain the pressure at substantially a desired value. Downstream of the switch B is a Leister heater C which is rated to achieve temperatures of up to 250°C at air flow rates above the minimum requirement of the heater C. The air temperature at the outlet from the heater C is monitored by a

thermocouple D for controlling the heater C. The hot air can be fed through a nozzle E, or through a by-pass F into a return pipe G having a condensate drain H. Downstream of the return pipe G is a condenser I followed by a filter J which is connected by a return pipe K to the intake of the air fan A. In Figure 1, the nozzle E is shown directing hot air into a carton L which is being advanced step-by-step by a chain conveyor (not shown) along with a number of other cartons (also not shown) through an aseptic chamber M of the aseptic packaging machine. Prior to arriving at the station shown in Figure 1, the open-topped, bottom-sealed carton L has been sprayed internally with hydrogen peroxide (and possibly also exposed to ultra-violet radiation) in order to sterilize the internal surface of the carton. The hot gas blown into the carton L by the nozzle E atomizes or vaporizes the hydrogen peroxide in the carton, the mixture being expelled through a square-mouthed hood N fitted into the top wall O of the chamber M, the uppermost extremities of the carton L lying just below the bottom surface of the wall O and registering with the lowermost extremities of the hood N. As the mixture flows over a water-chilled coil P and past a chilled jacket Q, both of the condenser I, the hydrogen peroxide vapour condenses and runs back down the pipe G to the drain H and thence to a hydrogen peroxide collector R, whence the hydrogen peroxide can be recycled, if desired. Should the stepwise advance of the cartons through the chamber M have to be stopped for some reason, then it is disadvantageous if the hot gas continues to be fed through the nozzle E into the chamber M. In those circumstances, and as shown in Figure 2, a flap valve S disposed in the by-pass F is opened and the fan A serves to draw the hot gas from the heater C through the by-pass F into the return pipe G and also draws sterile air from the chamber M via the hood N.

The through-flow cross-sectional area of the return pipe G is less than the through-flow cross-sectional area of the hood N in order to increase the velocity of the mixture, to minimise the time taken for the mixture to flow from the hood N to the condenser I. However, the through-flow cross-sectional area for the mixture in the condenser I is significantly greater than the through-flow cross-sectional area of the pipe G, to maximise the time taken for the mixture to flow through the condenser I, in order to encourage condensation of the hydrogen peroxide vapour. The filter J is relatively fine, for example, is a 5 micron filter, in order to filter out hydrogen peroxide vapour which may not have been removed by the condenser I. The chamber M has a main inlet and a main outlet (both not shown) for sterile air.

Referring to Figures 3 and 4, the machine 1 for

carrying out aseptic packaging includes at one end of the machine a conventional device 2 for pre-forming (including bottom sealing) gable-topped cartons. The open-topped, pre-formed cartons are taken to the other end of the machine through a closed channel 3 by means of a chain system. The channel 3 is bounded by covers 4 individually liftable about hinges to give access to the channel interior. At this front end of the machine, the open-topped cartons are advanced stepwise and in a vertically upright condition by means of conveying chains 5 along a hairpin-shaped path P of which an advance leg extends along the machine towards the device 2 and a return leg extends along the machine 1 back towards its front end. The cartons exit from the channel 3 directly into the aseptic chamber M which totally encloses the chains 5 and which is provided with access covers 6". The chains 5, which are arranged coextensively one above another, have projecting therefrom outwardly of the path P long lugs 5' which extend beyond guide strips extending along the path P, the cartons being received among and advanced along the path P by the long lugs 5' and being supported at one side by the chains 5 and at the other side by the guide strips. The chains 5 carry the cartons first of all to a top pre-breaking device 7, where the open top of each carton is pre-broken. Then the cartons are passed beneath high-intensity ultraviolet germicidal lamps 8 which extend over a section of the hairpin-shaped path p which forms at least a major portion, in the present case in fact a major portion, of the length of the advance leg of the path P. In the region of the beginning of this section of the path P, there is arranged some means for introducing into the interior of the carton a fine spray of hydrogen peroxide ( $H_2O_2$ ). This means comprises a nozzle arrangement 7' incorporated in the pre-breaker 7 and serving to spray particularly the inside of the carton with  $H_2O_2$ . The combined effect on the interiors of the cartons of the ultraviolet radiation and the hydrogen peroxide has a synergistic sterilizing action which is highly germicidal. At the downstream end of this path section, the chains 5 carry the cartons round through 180° to start the return leg of the path P. On this leg, the cartons first arrive at the agent-removing station shown in Figures 1 and 2 and then at a filling device 9 where the cartons are filled with an aseptic product, for example long-life milk, the cartons then proceeding to a top heating device 10 where thermoplastics surfaces of the top of each carton are heated to a tacky condition, and the cartons are then advanced to a top sealing device 11 where the gable tops are sealed. The cartons leave the aseptic chamber M at an exit hole 6" therefrom at the front end of the machine. Throughout the operation of the machine, aseptic

air is fed from a main sterile air filter to aseptic air inlets 13 and 13' of the chamber M, in which chamber the aseptic air flows from the inlet 13 relatively smoothly to the front end of the chamber M, where the aseptic air leaves via an aseptic air outlet 14, towards a filtering system (not shown). Not only does the aseptic air act as a scavenging gas removing microbes and hydrogen peroxide from the chamber M, particularly tending to prevent the microbes and the hydrogen peroxide from being carried up to the filling device 9, but the aseptic air also maintains the interior of the chamber M at a pressure slightly above atmospheric and thus discourages the entry of ambient air into the chamber.

The device described with reference to Figures 1 and 2 has the following advantages:-

1. The sterile air is always drawn into the device only through the extraction hood N from the sterile chamber M, so that it is the sterile air supplied as a main supply to the chamber M which is used.

2. When the machine is not producing cartons, the hot air from the heater C by-passes the nozzle E and the hood N through the by-pass F into the return pipe G. Thus, very little power would be consumed by the heater C in maintaining the hot air at the correct outlet temperature, because it is being returned relatively rapidly to the intake of the fan A. During this recirculation, the oxygen content of the air is reduced. For juice packing especially, such oxygen reduction is beneficial and significantly reduces the known problems with juices with a vitamin C content, when the air within the carton partially mixes with the juice during filling of the juice into the carton.

3. The flap valve can be opened by a shift register associated with the cartons when no cartons are present, the shift register being closed when cartons again begin to approach the station shown in the drawings.

4. Even though during the production of cartons the hot gas forced into the carton by the nozzle E will tend to rise naturally, this effect is reinforced by the suction effect which the fan A produces in the hood N.

5. Although the hot air from the heater C will lose temperature both in the carton and in the condenser I, its temperature still remains relatively high and the recycling of the air still reduces the power requirement for the heater and reduces the oxygen content within the carton.

6. The conventional problems with residual hydrogen peroxide within the sterile chamber or with the residual hydrogen peroxide being blown out into the working environment, are substantially eliminated.

7. The air in the circuit is partially changed

at every index of the cartons, because, as a carton moves from the station shown in the drawings, some hot air will be blown from the nozzle E into the chamber M and some new sterile air will be sucked into the circuit through the extractor hood N, although the proportion of new sterile air would be only approximately 10%. This effect of blowing some hot air into the chamber and drawing of new sterile air into the circuit arises because of the gaps between the cartons as they index along the machine. Because approximately 90% of the hot air blown into the chamber M during operation of the machine is drawn back through the extractor hood N, the temperature of the sterile air within the chamber tends to remain relatively low.

8. The blowing of hot air onto the hydrogen peroxide on the inside surface of the carton L increases the bactericidal effect upon the inside surface of the carton.

As an alternative to the coil-and-jacket condenser I a fine cold water spray system can be provided to condense the hydrogen peroxide vapour and wash it out of the mixture.

## Claims

1. An aseptic packaging method, comprising advancing packaging material (L) through a chamber (M), causing a main stream of substantially sterile gaseous substance to flow into said chamber (M) through first inlet means (13), around said material (L) in said chamber (M), and out of said chamber (M) through first outlet means (14), applying to a surface of said material (L) a sterilizing agent, allowing said sterilizing agent to act in a sterilizing manner upon said surface, and operating pumping means (A) to introduce through second inlet means (E) a second stream of substantially sterile gaseous substance to flow over said surface and to entrain the sterilizing agent, characterized in that the second stream comprises sterile gaseous substance drawn from the main stream through second outlet means (N) of said chamber (M) by said pumping means (A).

2. A method according to claim 1, and further comprising, downstream of said second outlet means (N) and upstream of said second inlet means (E) relative to the flow of said second stream, removing such entrained agent from said second stream.

3. A method according to claim 2, and further comprising sterilizing said second stream between the removal of said agent therefrom and the return of said second stream through said second inlet means (E).

4. A method according to any preceding claim, wherein said packaging material (L) comprises con-

tainers (L) which advance one after another past said second inlet means (E) and said second outlet means (N).

5. A method according to claim 4, wherein each said container (L) has a closed axial end and an open axial end and said second inlet means (E) and said second outlet means (N) so influence said second stream that, for each container (L), said pumping means (A) causes said second stream to flow in one axial direction of the container (L) from said open axial end towards said closed axial end, where said second stream reverses its flow direction, and then to flow in the opposite axial direction to said open axial end.

6. A method according to any preceding claim, and further comprising stopping the advance of the packaging material (L) and, while said packaging material (L) is stationary, interrupting the introduction of said second stream through said second inlet means (E) by diverting said second stream through a bypass (F) which bypasses said second inlet means (E) and said second outlet means (N).

7. Apparatus for aseptic packaging, comprising a chamber (M), conveying means (5) for advancing packaging material (L) through said chamber (M), first inlet means (13) to said chamber (M) for introduction of a main stream of substantially sterile gaseous substance to flow around said material (L), first outlet means (14) from said chamber (M) for removal of said main stream therefrom, applying means (7') for applying a sterilizing agent to a surface of said material (L), second inlet means (E) to said chamber (M) for introduction of a second stream of substantially sterile gaseous substance to flow over said surface and to entrain the sterilizing agent, and pumping means (A) for producing said second stream, characterized by second outlet means (N) from said chamber (M) for removal from said chamber (M) of gaseous substance of said main stream to constitute said second stream, and duct means (E,G,K) connecting said second outlet means (N) to said second inlet means (E).

8. Apparatus according to claim 7, and further comprising, at a location along said duct means (E,G,K), agent-removing means (I) for removing agent from said second stream.

9. Apparatus according to claim 7 or 8, wherein said packaging material (L) comprises containers (L) and said conveying means (5) advances said containers (L) one after another along a path extending past said second inlet means (E) and said second outlet means (N).

10. Apparatus according to claim 9, wherein said second inlet means (E) and said second outlet means (N) are arranged adjacent each other, are directed transversely to said path and substantially axially of each container (L) in turn.

11. Apparatus according to claim 10, wherein

said second inlet means (E) and said second outlet means (N) are of an overall throughflow cross-section which has a dimension along said path substantially equal to the dimension along said path of each container (L).

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12. Apparatus according to claim 11, wherein said overall throughflow cross-section has a dimension in a direction perpendicular to said path equal to the dimension in said direction of each container (L).

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13. Apparatus according to any one of claims 10 to 12, wherein said second inlet means (E) and said second outlet means (N) are arranged one around the other.

14. Apparatus according to claim 13, wherein said second inlet means (E) and said second outlet means (N) are arranged one encircling the other.

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15. Apparatus according to any one of claims 7 to 14, and further comprising a bypass (F) extending from downstream of said pumping means (A) to upstream thereof and bypassing said second inlet means (E) and said second outlet means (N), and diverting means (S) operable to cause said second stream to flow through said bypass (F) instead of into said chamber (M).

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16. Apparatus according to claim 15, wherein said diverting means (S) comprises a valve (S) in said bypass (F).

17. Apparatus according to any one of claims 7 to 16, wherein the through-flow cross-sectional area of said second outlet means (N) is greater than that of said duct means (G) at a location immediately downstream of said second outlet means (N).

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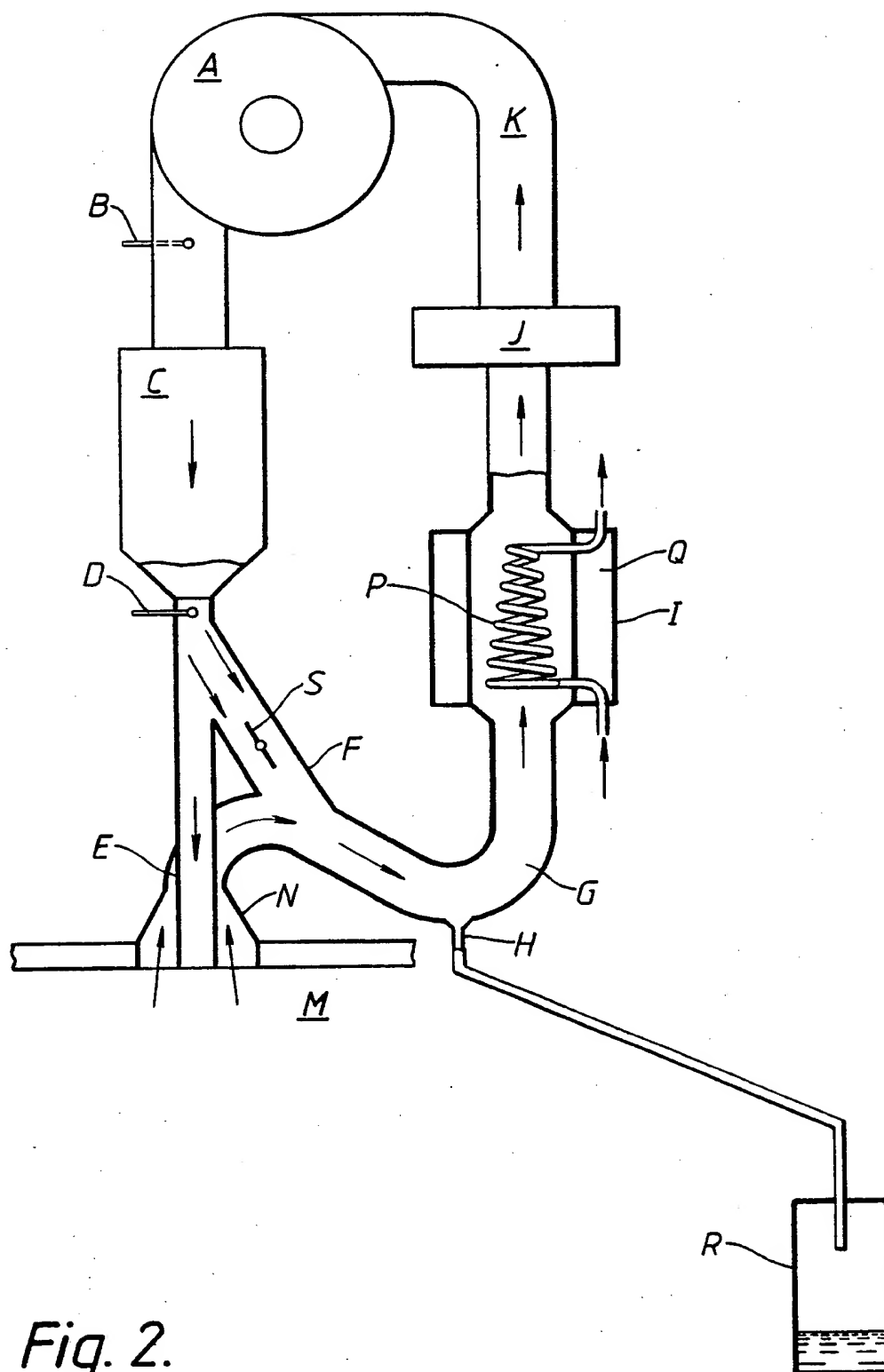
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*Fig. 2.*

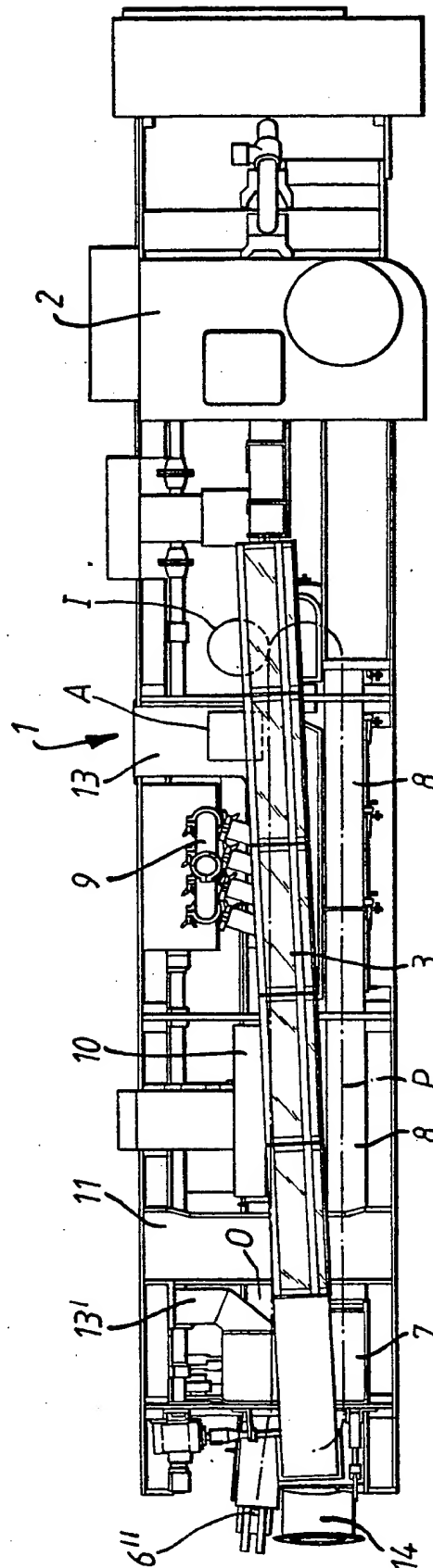
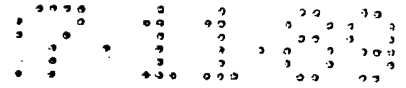


Fig. 3.

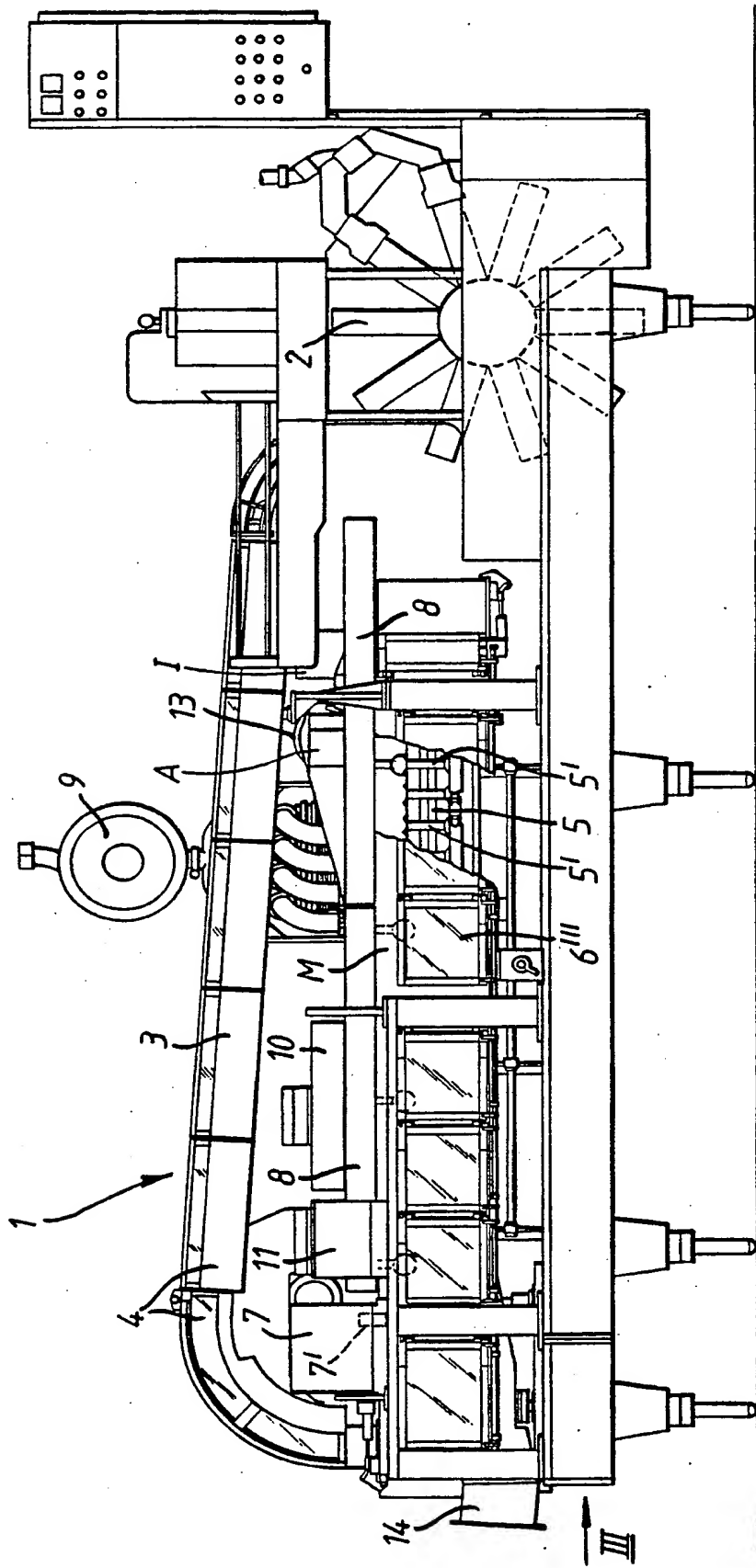
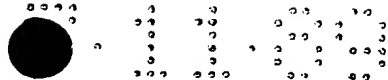


Fig. 4.



European Patent  
Office

# EUROPEAN SEARCH REPORT

Application Number

EP 89 30 9781

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
D,X	EP-A-0 082 368 (ROBERT BOSCH) * Page 6, line 14 - page 9, line 16; figures *	1,6,7, 15	B 65 B 55/10
D,A	---	3,5	
D,X	US-A-4 296 068 (M. HOSHINO) * Column 18, line 3 - column 19, line 32; figures 1,13 *	1-5,7-9	
D,Y	---	10-14, 17	
D,Y	US-A-4 055 035 (AB ZIRISTOR) * Column 2, line 23 - column 4, line 4; figure *	10-14, 17	
A	US-A-4 375 145 (R. MOSSE) * Column 3, line 16 - column 4, line 14; figures 1,2 *	1,7	
A	US-A-3 723 060 (R. LISIECKI)		
A	DE-U-8 712 317 (S. AMMANN)		TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	GB-A-1 414 241 (ALTSTADTER VERPACKUNGVETRIEBS)		B 65 B
A	WO-A-7 901 074 (EX-CELL-O)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 20-12-1989	Examiner JAGUSIAK A.H.G.
<b>CATEGORY OF CITED DOCUMENTS</b>			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P0401)